AVIATION

AND

AERONAUTICAL ENGINEERING

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View of the United States Aviation School at San Diego, Cal.

MARCH
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SPECIAL FEATURES

SEAPLANE FLOAT FORMS
AIR MANEUVERS AT MINEOLA
THE LATE COUNT FERDINAND VON ZEPPELIN
AN AMERICAN ENGINE FOR PURSUIT AIRPLANES
COURSE IN AERODYNAMICS AND AIRPLANE DESIGN
THE INFLATION AND MANIPULATION OF DIRIGIBLE BALLOONS

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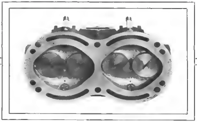

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MARCH 15, 1917

AVIATION
AND
AERONAUTICAL ENGINEERING

VOL. II. NO. 4

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AVIATION AND AERONAUTICAL ENGINEERING

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Vol. II March 15, 1917 No. 4

OWING to the filibuster at the end of the last session of Congress the Army appropriation bill failed to pass and the urgent deficiency bill also did not become a law. The failure of these two bills to pass is having the effect of making it extremely difficult for the Aviation Section, Signal Corps, U. S. A., to continue the upbuilding of the Army's aerial arm in an orderly and systematic manner.

The urgent deficiency bill contained an amendment authorizing the Aviation Section to spend \$4,500,000 out of the \$13,281,666 appropriated for military aeronautics, August 29th 1916, for the purchase of permanent sites and buildings.

The organization of Army training schools and the establishment of air stations by the Army is greatly hampered by the failure of the urgent deficiency bill to pass. Under the law the Army is not allowed to erect permanent buildings on leased land. The Army training schools at San Diego, Mineola and Memphis are all established on leased land.

The Aviation Section of the Signal Corps desires to purchase many permanent sites. It therefore does not consider it wise to spend too much money upon temporary hangars. Satisfactory temporary hangars are difficult to get promptly. One effect of this situation is that at Mineola there are many more machines than there are hangars for storing the machines in. For this reason some of the recently arrived machines have not yet been set up.

At Memphis Captain Morrow is using canvas hangars. Airplanes and airplane engines are delicate pieces of mechanism and the protection afforded by canvas hangars can hardly be of the very best.

An extra session of Congress has been called and it is to be hoped that one of its first acts will be to pass the appropriation bills and the urgent deficiency bill. Meanwhile the work of training aviators for the Army is being delayed.

The Passing of a Great Inventor

The death of Count von Zeppelin finds the question of the exact value of the large rigid dirigible still problematical. Offensively, it may be said that Zeppelins are failures, but owing to the limited carrying capacity of heavier-than-air machines there is no doubt that rigid lighter-than-air craft, which can travel at 75 miles per hour carrying two and a quarter tons of munitions besides their fuel and crew, have a distinct place of usefulness in war. At this moment the United States Navy is at work on plans for a large rigid dirigible. It is always possible that our Navy may go into action 2,000 miles from its nearest base. If the Navy were called upon to engage in such an action the presence of a large rigid dirigible equipped with powerful radio might perform the function of eyes for the fleet.

A brief review of Count von Zeppelin's failures and disappointments should teach the lesson that this country cannot hope to build huge dirigibles without a certain number of setbacks. The present day Zeppelin is the culmination of forty-three years of arduous theoretical work and more than twenty years of practical experience, not to mention the expenditure of millions upon millions of dollars.

Count von Zeppelin's death marks the passing of a great practical scientific inventor who succeeded in perfecting, after years of patient and discouraging endeavor, a type of aircraft which has a definite field of usefulness.

The lesson which his work should teach the United States is the value of endless patience and scientific application of sound engineering to pioneer work.

Activity at Army Schools

The approach of Spring is the signal for a great stimulus to Army aviation. The first week in March witnessed about 250 hours of successful training flights at the Army Flying School at Memphis, Tenn., and also the successful institution of a regular program of air problems which the First Reserve Aero Squadron at Mineola, L. I., will practice every week for several months.

The Mineola flying field is closed to all civilians, except those with special permits, by orders of the War Department. This condition exists because of the international situation. While it is imperative that every proper precaution be taken against injury to Government property, the War Department might do well to consider the advisability of opening a certain part of the field on Saturday afternoons so that the public could have tangible evidence of what the Aviation Section of the Army is actually doing to build an adequate air fleet for the United States. Such action would serve a useful purpose.

Seaplane Float Forms

By Charles G. MacGregor

The float of a seaplane is that part of the machine which enables it to float on, rise from and alight on the water. It performs the same functions on the seaplane as the landing gear on the land machine, and is virtually a small boat divided into water-tight compartments, connected to the machine proper by steel or wood struts and wire stays of sufficient length to give good clearance for the propeller from the hull and the water. It is necessarily built very light and strong enough to withstand the enormous impacts to which it is subjected, it is of such a force as best suits its peculiar duties when on the water, at the same time offering as little head resistance as possible when the machine is in flight. The seaplane when on duty must be able to put to sea in anything but lifeboat weather. It may have to run out of the harbor in the face of a strong breeze and a heavy sea, or be launched from the mother ship either by being hoisted over the lee side by a derrick or by being projected from the deck of the ship by means of a launching catapult, or it may be carried out to sea on the back of a submarine, which acts as a floating dock by submerging when launching the seaplane into the water, and emerging from under when taking it out on its back.

Fig. I

On getting under way in a seaway, the float is often completely submerged in solid water, then, again, it will nose into the waves as the seaplane gathers speed. On reaching planing speed (which is from about 20 miles per hour and up, until the machine attains the maximum or "getting off" speed), the seaplane will often jump clear out of the water, but, not having gained enough speed to sustain it in flight, it stalls and flops in again, sometimes flat on the bottom or flat on the tail of the float, or even at a most dangerous angle. This hopping, as it is called, may be repeated over and over again until sufficient speed has been gained to enable the machine to jump from a wave crest and continue its flight in the air. On alighting, the buffeting is no less severe, and, when flying with a cross wind, the danger is increased, as the machine will skid unless the float should be of such a form as to minimize this.

Where two floats are used instead of the single one, the whole landing gear is subjected to most severe straining, as when the bow of the one float is under water, bearing almost the whole weight of the machine, the tail of the other float may be completely out of the water or supported by another wave, thereby putting the whole of struts, wire gear and floats under very severe twisting, straining and tension. It is here that great rigidity or extreme flexibility, in the form of shock absorbers, is a commendable feature in the float attachments.

It will thus be seen that the seaplane is no fair weather machine, and that the float, apart from its high speed and planing qualifications, performs a more important function than is generally appreciated.

DESIGN

In determining the size of the float when it is being designed, several important points must be considered. The float supports the weight of the whole machine, and should have an excess buoyancy of from 70 to 150 per cent of the weight of the complete seaplane in its loaded condition. This reserve buoyancy enables the machine to recover quickly when the float is submerged in a seaway. When running on the surface there is always a possibility of the float being damaged, such as having the sides or bottom pierced by shell fire or by striking a partially submerged log or driftwood, therefore, the interior is divided into independent water-tight compartments, usually about six in number and arranged in such a manner as to insure the machine against sinking or capsizing when any one compartment is flooded.

There are two distinct types of landing gear, the single float and the twin floats.

THE SINGLE FLOAT

When Glenn H. Curtiss first experimented on Lake Keuka, N. Y., in 1910, he used on his machine a single float, which was an ordinary canoe (Fig. VI-A) lightly decked over. Since then the single float has been used extensively, and makes a very satisfactory and seaworthy outfit, provided the machine is of the single engine type (Fig. I). There are few struts and wires, the air resistance is comparatively small, and in a seaway there is less racking and straining on the whole gear than is the case with the twin float landing gear.

Fig. II

The length and breadth dimensions of the float are important.

In a head sea the machine is subjected to a considerable amount of pitching and rolling. When, by the action of the waves, a boat oscillates in a longitudinal direction about a transverse axis, it is said to "pitch," and when it oscillates in a transverse direction about a longitudinal axis it is said to "roll." Rolling and pitching generally take place together in a seaway. "Heaving" is the vertical motion given to a boat by the waves. So it is imperative that the float should have sufficient longitudinal stability when pitching, to prevent the machine falling back on its tail or forward on its nose, and have sufficient lateral stability to eliminate any undue amount of rolling over on the wing tips. There are instances where the main floats have been too short, lacking in stability, and the machines have fallen back on their tails and finally turned right over on their backs. This can be prevented by the use of a small float fitted below the tail (Fig. I-F), or by fitting a water-tight tank inside, at the after end of the body (Fig. I-G). The bow of the float must have sufficient bearing surface to prevent the machine tipping over on its nose when alighting or getting under way. This tipping tendency can be minimized by keeping the center of thrust of the propeller as low as practicable.

To prevent the wing tips dipping or being submerged when the machine is heeled over by a sudden gust of wind, small floats are attached to the extremities of the wings (Fig. I-C). These assist the main float in maintaining lateral stability. A flexible planing board or paddle is usually fitted to the underside of these floats (Fig. I-E), to absorb the shock if the float strikes water when running at high speed. The buoyancy of the float materially assists the machine to recover quickly to an even keel. These wing and tail floats should be of sufficient buoyancy or volume to support the machine when inclined over on the wing to port or starboard, or back on the tail. They are fitted either close up to the main structure (Fig. VII-C-D-E) or held sufficiently far below by means of struts and wires, to keep them just clear of or touching the water when the machine is at rest (Fig. VII-A-B).

When a seaplane is running at low speed on the water, steering is very difficult because of the insufficiency of wind pressure on the rudder to keep the machine under control. The fault can be overcome to a certain degree by the use of water

rudders. These can be arranged for either on the wing floats in the form of small horizontal flappers or drags fitted to operate below the planing boards (Figs. I-J and VII-A), or by arranging the tail float so that it is partly submerged (Fig. I-H) when under way, and having it placed so that it can be turned to port or starboard with the air rudder, the water bears on the flat of the side. By this means it performs the duties of a float and a water rudder at the same time. Another method is by the use of a small water rudder. The air rudder post is extended down to a point below the water, supporting the after end of the float and a small metal rudder blade (Fig. VII-F). This rudder is sometimes arranged to operate independent of the air rudder. If the main float is sufficiently long, the tail float can be dispensed with (Fig. II), but the wing floats should always be used with the single main float.

Fig. III

TWIN FLOATS

For good all round service, the twin-float landing gear (Fig. III) is very satisfactory. As already stated, the whole gear is subjected to most severe racking and straining, but apart from this it is a very stable, seaworthy and serviceable outfit. By the use of twin floats, the wing floats can be dispensed with, except in the case of some torpedo seaplanes where the floats are very close together (Fig. IV), but the tail float should be used where the main floats are short, as with the single short float (Fig. I). The main floats must not be spread too far apart, for when one float is submerged more than the other, the machine has a strong tendency to spin around quickly, due to the increased resistance of the immersed float, the decreased resistance of the emerged float and the leverage between them.

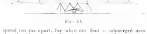


Fig. IV

For twin engine or twin body machines, they are particularly favorable in that each supports directly the weight of one engine or one body (Fig. III). This arrangement of floats is also most suitable where the machine is used as a torpedo-carrier or as a bomb-dropper. The torpedo is carried suspended from the cross braces between the floats, and just clear of the water (Fig. IV). When ready to be launched, the torpedo can be instantly released from the slings or brackets and dropped into the water; similarly the bombs have a clear drop from below the body.

HYDROPLANING

Before describing the various float forms, it is necessary here to give a very brief and simple outline of the theory of hydroplaning, for clearer understanding of the principles involved in the designing of the bottom or planing surface of the seaplane float.

The principle of hydroplaning can be very clearly illustrated by taking a flat stone or slate and throwing it on to the water's surface at a flat angle, so that when it strikes the water on the flat of its under face, the impact will cause it to skim along the surface of the water, sometimes in a series of jumps for a number of yards, until it loses its momentum. This is almost exactly the behavior of a float or hydroplane on reaching planing speed.

THE MULTISTEP FLOAT

The multistep or Fauber type hydroplane has from two to seven steps built in on the bottom, transversely and one ahead of the other (Fig. VII-C). This type is not quite practicable on the seaplane float when more than two steps are used, as these oppose the rocking motion so necessary on the seaplane float. With so many breaks on the bottom the resistance in flight would be increased. The construction would be heavier and more costly than the others.

TOPSIDE FORMS

The topsides, like the bottoms, are of various forms. The simplest is that with the flat sides and deck. Structurally, it is very simple, but the proportion of the weight to the strength is rather excessive. The efficiency of the flat deck, in freeing itself from water when submerged, can be improved by giving it a camber or slight round transversely (Fig. VI-C). The tails of many of the earlier types were built almost square at the back (Fig. VI-B), they were not conducive to the reduction of resistance or weight, and were slightly heavier and weaker than those which curved down from the deck to the tail without a break (Fig. VI-C). Fig. VI-D shows a very efficient form of stepless float, where an attempt has been made to introduce the streamline form as much as possible without sacrificing the seaworthiness.

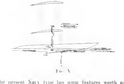


Fig. V

The present Navy type has some features worth noting, principally the V-bottom and the crowned or rounded topsides (Fig. VII-A). This form of topsides allows of a stronger and lighter construction being used than that of the other types, it is a fairly good streamline form, and when the float is buried in a wave, it will throw the water off and allow the machine to recover quickly, a very important asset when traveling in a rough sea. With a flat top under these same conditions it has a tendency to hold the water and make the machine act sluggishly.

WING AND TAIL FLOATS

Reference having already been made to the uses of the auxiliary floats, we will now discuss their general design and form.

They are built of either wood or metal, wood being found to be more satisfactory than metal, except in the smaller sizes and cylindrical forms. This cylindrical form is shown in Fig. VIII-A, the ends are conical and the bottom is flat, against which the planing board is fitted. This was one of the earliest types used and has been very satisfactory. It is suspended below the tail or wing by struts, so that it is just clear of the water with the planing board touching when the machine is at rest. In the larger size and V-bottom floats, the planing boards are dispensed with almost entirely.

Fig. "B" is of a simple streamline form suspended close to the surface of the water. "C" is one of the larger type, fitted close up to the wings or tail. It is of the concave V-bottom class and very efficient. "D" is another of the earlier

forms of metal floats, fitted with planing board and flat or slightly V-bottom These are so narrow and deep that a brace is necessary from the bottom to the wing beam. "E" is a similar type to "C" except that it is made to the same form of the body on top, with a straight V-bottom. Instead of having a planing board attached to the bottom, an ash skid is fitted to protect the rudder "F" (previously referred to) is similar to "B" except that the sternpost is vertical instead of horizontal, so that the water will have a clear run to the water rudder which is swung at the back.

The interior of each of these floats is divided into two or more water-tight compartments, similar to the larger floats, by cross bulkheads, which also help to stiffen the floats transversely.

Fig VI shows in outline some of the commoner types of stepless floats. "B" is a simple form from a building standpoint, and runs well in calm water, but, owing to the flatness of the bottom, the structure is apt to be strained by the severe impacts with the water, nor does this flatness help to prevent skidding. "C" is not quite so simple structurally as "B," but is a much better form to withstand impacts Being V-shaped, it cuts into the water more or less, and thereby relieves the strain on the bottom structure It is comparatively simple to build, prevents skidding or side slipping to a great extent, and is an altogether satisfactory form for general uses

"D" has all the qualifications of "B," with the exception that it is more difficult to maintain the concave bottom form when building, this concavity is increased at the forefoot or in the bow sections, and materially helps to reduce the pounding of the waves on the planking. "E" is not used much on floats on account of its width not being sufficient to get the full benefit of this type of bottom, which is known as the "Wave-collecting" form, and is adopted mainly in motorboat design and sometimes in flying boats

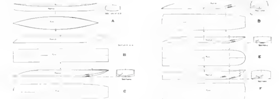


Fig VI

Fig V shows diagrammatically the various forces acting on a seaplane when running on the water With the forward motion of the float given by the thrust of the propellar, the pressure of the water on the planing surface, which is inclined at an angle varying from 3° to 5° when running, supplies an upward acting component which lifts the float nearer to the surface as the speed increases As the speed increases the displacement decreases, both by the increase of the lift in the planing surface and the lift proper of the wings When running at low speed before planing starts, there is a great deal of resistance due to wave and eddy making, which diminishes rapidly as the higher planing speeds are attained and when the lift of the wings becomes effective A break is made in the streamline of the bottom so that the machine can get off the water easily This is accomplished by the introduction of a transverse "jog" or step in the planing surface, varying in depth from 1½ to 5 inches (Fig V) To relieve the bottom at the back of the step from any suction or eddies, air is allowed access to this part through tubes, usually led down from the deck to the bottom abaft the step These air tubes are not essential where there is a very pronounced "V" on the bottom, or where there is plenty of reserve power

FLOAT FORMS

The floats now in general use are of various forms on the topside, bottom and planing surface These can be classified as follows:

1 The stepless float
2 The step float
3 The multi-step float

The topside form is not governed by the bottom form, so that any of those shown in Fig VI can be combined with any other type.

THE STEPLESS FLOAT

In the stepless float there is no break in the bottom, so that it forms the entire planing surface The tail end takes the place of the step, therefore the float must leave the water at this part This form of bottom is practicable on the short floats only, of lengths up to fifteen feet, because the break or step should be kept not far from a point directly below the center of gravity of the machine, the farther it is from the center of gravity the more difficult it becomes to get the machine off the water.

"F" is the "Viper Sea Sled" type of hull, and has been very successful and seaworthy for the ordinary seagoing launch, but it has not been developed in seaplane float design on account of its unusual form, the inverted V, which makes the introduction of the step on the planing surface a very unsatisfactory proposition without the step the machine would require a large amount of reserve power to get off the water Great transverse strength is required in the bottom structure to resist the outward pressure of the water on the bottom, tending to split it at "A", this necessitates the carrying of more weight than is required for the ordinary V bottom, so that this is detrimental to its adoption on the seaplane float. It is, however, very easy in a seaway, and very high speeds have been attained by its use

THE SINGLE STEP FLOAT

The qualifications of the planing surfaces of the stepless floats, apply equally to the single step float This type is the one most commonly used Having only one step, air resistance is minimized, and by placing this in proper relation to the center of gravity, the machine will balance well when planing. The best position for the step is roughly from about 6 to 36 inches abaft the center of gravity of the machine Should the step be placed ahead of this point, the machine will be inclined to porpoise, thereby rendering it liable to the smashing of a wing by excessive rolling, or tipping over on the nose and capsizing

When running at high speed, the straight V-bottom throws a thin sheet of water and spray out on each side, which are caught by the propeller or propellers, thereby drenching the machine To prevent this, spray strips are attached to the chines or outer edges of the planing surface (Fig. VII-A), which deflect the water downward. Fig VII-B illustrates a type of float used extensively in Europe but not adopted in this country The design is the outcome of extensive tank

model experiments made in England (see *British Report*, 1912 1913)

The design is peculiar in that it shows a flat bottom, flaring bows, and rather a fine entrance, it depends on its length for

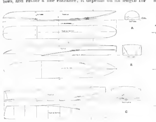


Fig. VII

longitudinal stability The bearing surface of the bow increases very rapidly as the bow is depressed, on account of the flaring sides When being towed in the tank, the model threw a thin sheet of water out on each side, close to the sides, this was deflected by fitting the spray strip along each side

In the single step float the tail surface does not act as a planing surface, therefore it should rise from the step to the stern at an angle of from 3° to 6°, so that there will be no opportunity of causing a suction action when the machine is running on the step and about to get off the water This surface is usually flat or of V-form, the latter being preferable, for when the float strikes the water with the tail, the V-form relieves the shock

On reaching the higher speeds just before leaving the water, it is possible, with the single step, to rock the machine about this point by means of the controls, in order to get a flatter angle of planing surface, and adjust the wings nearer to the angle of incidence necessary for flight. This maneuver is rendered difficult where more than one step is used on the bottom, as these tend to oppose the rocking motion.

Several tests have been made with attached planes, in the nature of plates fitted to the bottom with struts With the

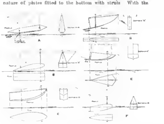


Fig VIII

bracing necessary for their attachment to the hull, they add a considerable weight to the machine besides the float weight, and at this point of attachment the force of the weight of the whole machine is concentrated, then, with the jumping action of the seaplane when planing, this force is enormously increased, then again they are most awkward when handling or stowing the machine either on shore or aboard ship

Sometimes more planing surface is required on a single step afloat without increasing the volume or dimensions of the body of the float This can be obtained by extending the planing surface out on each side, from 5 to 10 inches, according to the additional amount required, the outer edge curving in at the fore-end. This extends from the step forward to within about 24 inches from the stem on each side. Additional buoyancy can be obtained, without adding much to the weight, by planking over the braces from the edge of the planing surface to the hull side, thus making two water-tight compartments called fins or sponsons (Fig VII-A)

An American Engine for Pursuit Airplanes

To meet the demand for an extremely light aeronautical engine for use in pursuit machines and in training work, the General Vehicle Company of Long Island City has made arrangements with the Gnome and Le Rhone Engine Company of London to build and sell 9 cylinder 100 h p. Gnome engines in the United States The exhibit of this company at the recent Pan-American Aeronautic Exposition attracted great attention because of the fact that it was announced at the exposition that the United States Government had ordered one hundred of these engines for Army and Navy use

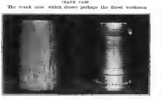
In material and workmanship, as well as developed horsepower, these engines are equal to similar engines produced in France and England The fine workmanship has gone far to solve the problem that has confronted the manufacturers of how to get an engine of small weight per horsepower for use in scouting airplanes The 100 h p Gnome engine is used abroad in small scouting airplanes for short flights of from one and one-half to two and one-half hours in work where tremendous speed and climbing ability are required. These little machines can dodge and outmaneuver larger planes, and can land in and get out of fields which heavier airplanes cannot use

CYLINDERS

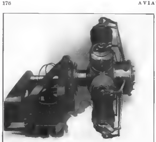
The engine is of 9 cylinders of 4.8 in bore by 5.9-in stroke Each cylinder is machined from a drop forging The original drop forge weighs about 88 lbs the finished cylinder 5½ lb Each cylinder is drilled near the bottom with a number of circular ports connecting the interior of the crank case with the cylinder

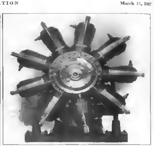
CRANK CASE

The crank case which shows perhaps the finest workman



Rough Casting and Finished Cylinder





Side and Front Views of the 100 H P Engine Made by The General V[illegible] Co

ship of any airplane engine part now on the market in the United States, is made in two pieces fastened together by bolts. The halves of the crank case clasp the cylinders at their base. The cylinders are prevented from turning in their setting in the crank case by keys

The ports are uncovered by the pistons near the bottom of the stroke permitting a passage from the crank case to the cylinders (see Fig 1)

The exhaust valve and sealing is fixed at the extreme outer end of each cylinder by means of the usual castellated ring nut. The weight of this valve is so adjusted that its centrifugal action, when the engine is rotating is equal to that of the tappet rod and lever and thus the use of counterbalance weights, such as are fitted to the rocking levers of the ordinary Gnome engine, is avoided

The system of connecting rods is similar to the ordinary Gnome engine, and is composed of one master rod and eight small rods.

THE CRANKSHAFT

The crankshaft, which is hollow, is in two parts, but the smaller half can be dismantled from the front of the engine. The rear or large end of the hollow crankshaft is open to admit air and contains the petrol jet, while the front nose extension is closed

The petrol jet is shown in Fig 3. The petrol is supplied from its reservoir to a union on the crankshaft then passes along a copper pipe to the elbow. The jet which projects into the crankcase is held on to a nipple with a ground conical seat by a screw. It has eight holes which project the petrol downwards in the direction of the flow of mixture towards the opening ports in the cylinder

THE CAMSHAFT

The camshaft, which is fitted at the small end of the crankshaft, turns at half the speed of the engine and in the same direction and is operated by the usual satellite pinions

Lubrication is by means of the usual Gnome pump, with forced feed to the gudgeon pins

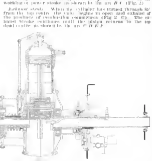
CYCLE OF OPERATIONS

The engine works on the four-stroke cycle. Consider a cylinder in which the piston is on the compression stroke and follow the engine through two revolutions.

Ignition which is "fixed," is set to take place 15° to 20° before the top dead centre (A, Fig 2)

Working stroke After ignition the piston descends on the working or power stroke as shown by the arc *B C* (Fig. 2)

Exhaust stroke When the cylinder has turned through 85° from the top centre the valve begins to open and exhaust of the products of combustion commences (Fig 2 *C*). The exhaust stroke continues until the piston returns to the top dead centre as shown by the arc *C D E F*



Cross-Section of Gnome Engine

Induction stroke. The valve still remaining open, the piston descends on the induction stroke, drawing air into the cylinder through the valve. 65° before the bottom centre the valve closes (*H*, Fig 2). On the piston continuing to descend, a partial vacuum is created in the cylinder until it is 20° from the bottom centre (*I* Fig 2)

At this point the piston uncovers the ports in the cylinder wall, making connection between the cylinder and the crank case, and a very rich petrol mixture is drawn into the cylinder. This rich mixture is diluted by the air already in the cylinder and the resulting mixture in the cylinder is a good combustible gas. The ports in the cylinder will remain uncovered until the piston reaches the point *J* (Fig 2), on the return stroke

Fig 1

Fig 2

Compression stroke On the closing of the ports the piston ascends on the compression stroke *J* (Fig 2), and when 20° from the top centre (*L*, Fig 2) ignition occurs, and the cycle of operations is repeated

Note.—*The timing diagram given in Fig 2 is an average from a number of tests. It is found that engines vary slightly and each engine is supplied with a special set of timing figures which should be used and adhered to.*

GENERAL DESCRIPTION

The general specifications of this engine are as follows:

Maker	General Vehicle Co., Inc
Model	100 H P Gnome Monosoupape (B-2)
Number of Cylinders	9
Bore	110 m/mx150 m/m stroke.
H P	100 and upward.
R P M	1200-1250
Weight of Engine with Ignition but empty	272 lb
Gasoline Consumption per Hour	12 (American) Gallons.
Oil Consumption per Hour	2 4 (American) Gallons

The Inflation and Manipulation of Dirigible Balloons

By C. F. Smyth

The handling of lighter than air aircraft is a subject requiring much experience and study. Work of this character is being undertaken daily in Europe. A study of European methods will undoubtedly be of value for this country

The usual method of inflating a balloon is to lay it out with the top exposed. The gas is conducted from the gasometers or generators through a main line of pipe to a point within ten feet of the balloon. The balloon is folded so that the inflating top is directly under the center and a tunnel is made of sand bags by laying them in parallel lines one foot apart from the generators to under the folds of the gas bag. The inflating hose is conducted through the tunnel to the main gas pipe.

As the envelope inflates, the sand bags suspended on the belly band are let down a foot at a time until the envelope is raised high enough to put the car in place. The suspension ropes are toggled to the car and sand bags are hung along the car to hold it securely to the ground. The junction from the main tube is fixed with a piece of flexible hose that will allow the gas to go only one way. This is done so that if anything happens to the main hose pipe there will be no reverse action of the gas blowing out.

Ballonets are placed in position before the gas is turned on, together with the valves and ropes required to operate them. Great care should be taken at all times to see that there are no holes in the ballonets, as the most essential thing in the mechanical end of inflating is to have absolutely tight ballonets so as not to destroy the specific gravity of the gas

GETTING AWAY

The usual method of preparing for an ascent is as follows. The necessary amount of ballast for the useful load is placed in the car of the dirigible and balanced in the hangar. The car is then conducted to the field, where a further balance is made by placing the passengers or carrying load in their places, although it is better to do this in the hangar. The captain or man who is to handle the dirigible must also be balanced and an amount of ballast equal to his weight is placed at the station of the captain while the balancing is being done

The captain usually stands far enough away from the car to watch the fore and aft balance, which is usually about two lengths of the entire envelope, this being the common practice in Europe. His commands are usually given by whistles.

When the requisite balance, which is usually a trifle heavier than air, has been made, he takes his position and liberates the water ballast, which is equal to his weight. The propellers can then be started at low speed. The ground men then walk along with the car suspended above their heads until the speed required to take control of the rudders is reached. It is essential that at all times the dirigible should be headed into the wind. The angle of ascent in a still atmosphere is usually about 10°, but should there be any wind, say, 10 miles an hour, the angle of ascent can be made perpendicular to the ground simply by manipulating the propellers so that the speed of the dirigible is equal to the velocity of the wind

The landing place is usually designated by spreading a flag or banner on the ground at a spot where the majority of the ground men are stationed. When there is a strong puffy wind blowing the ground men should be scattered over a larger area. When coming in at a speed equal to the velocity of the wind the drag rope is liberated from the car when at a height of about 100 feet. This unrolls and is dropped to the ground and is immediately caught by the ground men, thus liberating a certain amount of weight and holding the balloon in suspension. When once the balloon is near enough to the earth so that a sufficient number of ground men can take hold of the frame, the motors are cut off. The drag line is so arranged that when it is cast off and the ground men have taken hold of it, the balloon will head into the wind.

LANDING TO ENTER SHED

The usual method of housing a balloon after the landing has been made is to have the anchor catch the mooring device. Heavy ropes are pulled up and the dirigible is moored to a car and trolleyed into the shed. If a car is not provided for this purpose, a number of men hold the frame horizontal, a couple of feet above the ground, and twelve men take hold of the equator lines to steady the swaying of the envelope in case of a strong side wind. The strain on the ballonets is relieved by mechanically opening the valves until the gas pressure is equal to the surrounding air

EMERGENCY LANDING

In case of breakaway or of engine trouble, rendering the dirigible helpless if it is flying heavier-than-air and over territory unsuitable for landing, it becomes necessary to throw out an amount of ballast equal to the difference in load, thus ascending and floating along until a place is reached where a landing can be made. Such a spot is usually selected passing over a wood just before coming to a large field. To land immediately after passing the wood first drop the drag rope. Then by estimating the distance, drop the anchor into a barbed wire fence or a heavy tree. In case this cannot be done, drop the second drag rope and immediately open the gas valve and when within a few feet of the ground pull one or both ripping panels according to the prevailing weather. This will immediately discharge the gas, and as soon as sufficient gas is let out, allow one or two men to step out of the car and hold the nose ropes provided fore and aft to force the gas to the ripping panels

In case of landing over water, the dirigible is provided with a water anchor, which can be dropped over and held until assistance is secured

Course in Aerodynamics and Airplane Design*

By Alexander Klemin, A.C.G.I., B.Sc., S.M.

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and

T. H. Huff, S.B.

Instructor in Aeronautics, Massachusetts Institute of Technology

PART II—SECTION 7

Estimates of Weight Distribution

Difficulties of the Subject

Hardly any branch of practical airplane design offers such difficulties as the estimate of weights. A manufacturer who has built a number of machines and has kept careful weight schedules has valuable data in his possession, but is, as a rule, chary of making such data public. Even an experienced manufacturer, however, may be at a loss when building an entirely new type, particularly if the new type is of a very different size from that to which he has been accustomed.

Theoretical considerations apply only to a limited extent. Empirical formulas have been suggested by several authorities, but are only partly satisfactory. The authors' thanks are due to manufacturers and others for such data as they have permission to publish.

Weight Schedules for a Machine of the Unarmed Tractor Reconnaissance Type (Two Seater) Over 2500 Lb. in Weight

Full weight data can be published for one of the five machines which have been examined in Part 2, Section 1—the Standard H-3. The schedule for this machine is very complete, and is almost exactly in the form specified by the Aviation Section of the Signal Corps.

TABLE 1

Standard H-3. Hall Scott A-5, 135 h.p. Maximum speed 84 m.p.h. Minimum speed 46 m.p.h. Climb 3400 ft. Total wing area, 532 sq. ft. Weight loaded, 2651.6 lb. (6 hours). Weight bare, 1906 lb.

Body structure	
Details	
Longeron, forward upper right	6.0 lb.
Longeron, rear upper right	9.0 "
Longeron, forward upper left	9.0 "
Longeron, rear upper left	9.0 "
Longeron, forward lower right	9.0 "
Longeron, rear lower right	8.0 "
Longeron, forward lower left	8.0 "
Longeron, rear lower left	8.0 "
Vertical posts, total	19.0 "
Rudder post	12.8 "
Horizontal posts, total	11.5 "
Engine beds (two)	19.0 "
Engine bed, supporting posts	4.0 "
Engine plates, total	19.0 "
Radiator supports	27.6 "
Fittings, total	27.9 "
Rivets, bolts, nuts, screws, total	7.1 "
Wire and cable, total with terminal clips and thimbles etc.	21.1 "
Turnbuckles	10.0 "
Floor of cockpits	18.0 "
Tail skids	6.0 "
Body cover strips	7.0 "
Front and rear seats and supports	31.5 "
Cowling and body cover	59.5 "
Total	302.0 lb.
Percentage of total weight 11.4%	
Chassis	
Details	
Wheels and tires, 2 at 26" x 5"	57.0 lb.
Axles (1)	22.0 "
Struts (2)	25.0 "
Axle braces	8.5 "
Axle mounting and guides	12.0 "
Rubber shock absorber	2.5 "
Fittings	7.5 "
Wiring and turnbuckles	2.5 "
Fairing	1.5 "
Total	138.5 lb.
Percentage of total weight 5.2%	

Wing group	
Details for upper wings	
Front spar, total span 18' 5¾", 18' 8¾" length	29.0 lb.
Rear spar, total span 18' 9½", 19' 0" length	23.5 "
Compression posts or solid ribs (7)	16.2 "
Lightened ribs and straps (10 long, 7 short) total	18.4 "
Entering edge, 4 pieces	8.0 "
Trailing edge, 4 pieces	3.9 "
Edge pieces and cross battens	3.5 "
Fittings	1.2 "
Wire, clips and turnbuckles	11.5 "
Linen, undoped, and tape and tacks for taping	15.4 "
Dope and varnish	6.5 "
Flaps uncovered, total	20.6 "
Flap hinges and hinge fittings complete	1.1 "
Flap covering, dope and varnish	1.2 "
Unaccounted for	20.9 "
Total	178.0 lb.
Body wing section	16.5 lb.
Details for lower wings	
Front spar, total span 18' 5¾", 18' 8¾" length	1.0 lb.
Rear spar, total span 18' 9½", 19' 0" length	23.0 "
Compression posts or solid ribs (8)	19.5 "
Lightened ribs and straps (7 short, 9 long)	16.5 "
Entering edge, 4 pieces	8.6 "
Trailing edge, 4 pieces	7.0 "
Edge pieces and cross battens, hinge, block braces	5.5 "
Fittings	1.3 "
Wire, clips and turnbuckles	11.8 "
Linen, undoped, and tape and tacks for taping	15.9 "
Dope and varnish	5.9 "
Flaps uncovered, total	20.8 "
Flap hinges and hinge fittings complete	1.1 "
Flap yokes and yoke fittings	3.8 "
Flap coverings, dope and varnish	1.2 "
Unaccounted for	25.3 "
Total	190.0 lb.

	Weight	Area	Weight per sq. ft.
Upper wings	178.0 lb.	262 sq. ft.	.680 lb.
Body section	16.5	18	.920 "
Lower wings	190.0	262	.728 "
Total wing weight	384.5 lb.		
Percentage of total weight 14.32%			

Interplane struts, fittings, and wiring	107.8 lb.
Weight per square foot of wing area	.203
Percentage of total weight, 4.06%	

Tail surfaces	Weight	Area	Weight per sq. ft.
Vertical fin complete, covered and varnished	7.6 lb.	5 sq. ft.	.600 lb.
Vertical rudder	9.0	10	.900 "
Fixed horizontal tail	20.3 "	32 "	.635 "
Elevators	21.0 "	23 " "	.915 "
Total	58.1 lb.		
Percentage of total 2.0%			

Control system	
Combined rudder and dep. control with Control operators in rear cockpit only	26.2 lb.
Control wires, wiring and switches	4.4 "
Total	30.6 lb.
Percentage of total weight 1.1%	
Gasoline and oil	
Gasoline for 6 hours	390.00 lb.
Oil for 6 hours	37.5 "
Total	429.50 lb.
Percentage of total 16.2%	
Tanks	
Tanks and connections and supports (68 gallons fuel)	78.6 lb.
Percentage of total, 2.68%	

* This Course commenced in the August 1, 1916 issue of AVIATION AND AERONAUTICAL ENGINEERING will be completed in 24 issues.

Engine group			
Radiator complete and connections without water	46.0 lb.	Weight of radiator per hp.	.34 lb.
Engine complete without propeller, radiator or any water any oil, long exhaust tube or self-starter	558.5 "	Engine weight per hp.	4.15 "
Water for radiator piping and jackets (31 lb. carried in radiator alone)	60.8 "	Water weight per hp.	.090 "
Propeller complete and bolts	27.5 "	Propeller weight per hp.	.202
Long exhaust pipe	13.0 "		
Total	738.8 lb.		
Percentage of total weight, 27.77%			

Passenger and equipment	
Pilot	165.0 lb.
Passenger	165.0 "
Total	330.0 lb.
Percentage of total, 12.5%	
Equipment	
Instruments and instrument board and as supplied for rear cockpit	22.7 lb.
Same for front cockpit	9.2 "
Side pockets, both sides	3.0 "
Camshaft oiler	4.1 "
Speaking tube	1.8 "
Pyrene and brackets complete	1.7 "
Oil pressure line and sight oil	2.8 "
Tool kit and case complete	7.1 "
Total	58.6 lb.
Percentage of total weight 2.20%	

Summary of Weight Distribution for Standard H-3

Group	Weight	Percentage of Useful Load
Body assembly and equipment	370.5 lb.	13.00%
Chassis	138.5	5.23%
Wing group	384.5	14.52%
Interplane bracing	107.6	4.06%
Tail surfaces	53.3	2.00%
Control system	30.6	1.15%
Gasoline and oil	429.5	16.20%
Gasoline tanks and piping	78.5	2.95%
Engine group	738.8	27.70%
Passengers and equipment	330.0	12.50%
Totals	2651.9 lb.	100.00%

The Standard figures are fairly representative for this type of machine.

Percentage Table for Machines of About 2500 Lb.

In Table 2 are given figures compiled by Dr. J. C. Hunsaker for a number of typical machines. The percentage values seem to hold very closely for machines of the large tractor type.

TABLE 2

	Per cent
Useful load	
Personnel and equipment	13.1
Gasoline and oil, 6 hours	19.9
Engine weight	
Tanks and pipes	3.3
Engine and accessories	17.9
Radiator (empty)	2.2
Cooling water	1.7
Propeller and hub	1.0
Structural weights	
Body	8.2
Landing carriage	8.2
Direction surfaces	4.1
Wings	16.5
Wing bracing	4.0
Total useful load	32.9
engine weight	26.1
structural weight	41.0
	100

Weight Distribution for a Typical School Machine

Figures can be published for the Curtiss JN-4. Data was given in Section 1 for the JN-4B, but the difference between the two types is very slight.

Curtiss JN-4. OX 90 hp. engine. Maximum speed 75 mph. Minimum speed 43 mph. Climbing speed 3000 ft. in 10 min. Total wing area, including wing flaps, 367.0 sq. ft. Weight loaded 1902.29 lb. Weight bare 1261.5 lb. 4.4 hours fuel.

Part	Weight
Body assembly	290.00 lb.
Tail skid with rubber elastic cord (3 ft.)	2.75 "
Cushions	3.50
Total	296.25 lb.
Percentage of total load, 15.50%	

Chassis	
Details	
Landing gear braces with fittings	28.5 lb.
Axle	13.75 "
2 Aluminum bearings for shock absorbers and straps	2.00 "
2 Rubber shock absorbers (elastic cord 17 ft.)	3.50 "
2 Wheels 26" x 3" tire and 1½" hub	27.00 "
Total chassis group	76.75 lb.
Percentage of total weight, 4.03%	

Wing group Part	Weight	Area	Weight per sq. ft. of surface
Upper wings without flaps or fittings	120.00 lb.	172.2 sq. ft.	.772 lb.
Upper center section without fittings	13.00 "		
Lower wings without fittings	112.00 "	152.2 " "	.736 "
2 wing flaps with fittings	24.50 "	46.8 " "	.600 "
Total for wing group	269.50 lb.		
Percentage of total weight, 14.15%.			

Wing bracing and fittings Details Part	Weight
Upper wing fittings, 8 strut fittings, 4 fittings to center section	10.50 lb.
Lower wing fittings, 8 strut fittings, 4 fittings to body	9.00 "
2 Wing skids	2.29 "
4 Outer section struts (length of staggered struts = 61")	13.50 "
4 Intermediate section struts	17.50 "
4 Drift wires in nose from upper and lower planes	3.00 "
Flying landing and outer strut wires (not including center section)	24.00 "
4 Aileron wires with fittings	5.00 "
4 Short uprights for bracing aerofoils	1.00 "
Centre section struts	4.50 "
Centre section brace wire	3.50 "
Total	94.25 lb.
Percentage of total load 4.95%	

Tail surfaces	Weight	Area	Weight per sq. ft. of area
Vertical tail fin and fittings	14.00 lb.	2.5 sq. ft.	0.62 lb.
Rudder and fittings	10.00 "	10.2 "	1.02 "
Fixed horizontal tail with hinge fittings only	14.00 "	22.7 " "	0.62 "
2 Elevator flaps with wires and posts	14.50 "	17.5 "	0.83 "
Total	52.50 lb.		
Percentage of total, 2.76%			

Control system	
Steering post, rudder wheels with rudder wires and fittings	12.23 lb.
4 Elevator wires	1.50 "
Total	13.73 lb.
Percentage of total weight, .83%	
Gasoline and oil	
4.4 hours	272 lb.
Percentage of total load, 13.20%	

Tanks	Weight	Weight of tank per gallon
Gasoline tank with capacity of 37 gall.	28.1 lb.	.76 lb.
Percentage of total weight, 1.53%		

Engine group			
Propeller and hub	34.75 lb.	Weight per hp.	.386 lb.
Engine and accessories (including 2 hot air stoves, 3.75 lb., top of engine plates and side plate 20.15 lb.)	363.75	Weight per hp.	4.050 "
Radiator	55.79 "	Weight per hp.	0.620
Water	39.00 "	Weight per hp.	0.430 "
1 Water pipe and fittings	3.00 "		
Total	496.25 lb.		
Percentage of total weight, 29.10%			

Passengers	
Pilot	156 lb.
Passenger	165 "
Total	321 lb.
Percentage of total weight, 16.95%.	

Summary of Weight Distribution for JN-4-B

	Weight	Percentage of total load
Body assembly and equipment	296.25 lb.	15.50%
Chassis	079.75 "	4.03 "
Wings	269.50 "	14.16 "
Interplane bracing	094.25	04.95
Tail surfaces	052.50	02.76 "
Control system	015.73 "	00.83 "
Gasoline and oil	252.00 "	13.20 "
Gasoline tank and piping	028.10 "	01.52 "
Engine group	496.25	26.10 "
Passengers	321.00 "	19.96 "
Totals	1902.35 lb.	100.00%

Empirical Formulas and Values for Weight Estimates

Some empirical formulas and values are given here. Such empirical formulas can never be entirely trustworthy, since so much depends on the type of machine to be constructed, the type of construction to be employed for any particular part of the machine, and the factor of safety desired. Much greater reliance is to be placed on direct comparisons from actual machines and on actual computations from drawings.

Still, they may serve a useful purpose in the preliminary stages of design, when a rapid estimate is needed

(1) *Body*

Bare rectangular wooden longeron body, with fabric covering for small monoplane and biplane scouts about 1200 lb total weight, 70 lb is a good average figure. For large biplanes about 2500 lb total weight, 150 lb is a liberal allowance.

(2) *Seating*

About 10-12 lb. per person is sufficient

(3) *Single control system 30 lb*
Double control system 50 lb

(4) *Landing Gear*

A landing gear of about 1/12 the loaded weight of the machine can be easily designed.

(5) *Tail skid*

Is roughly 1/10th the weight of the landing gear

(6) *Main plane weights (surface alone)*

A fair average figure is 0.75 lb. per square foot of wing area, although wing weights will vary with size of machine, section employed, aspect ratio, strut spacing and numerous other features in design.

(7) *Weight of control surface*

Control surfaces with fittings and hinges may, with careful design, not exceed 0.5 or 0.6 lb per square foot

(8) *Tanks*

About 0.75 lb to 1.00 lb per gallon

(9) *Engine weights, fuel consumption*

Full values for these are available and will be given in a subsequent section.

(10) *Engine mounting*

One-eighth of the engine weight for a rotary type and one-twelfth the engine weight for a fixed type engine

(11) *Propellers*

A good rule is weight = $2.5\sqrt{hp}$

(12) *Radiators*

For radiators, manufacturers' figures will be given later, and empirical formulas are not necessary

(13) *Passengers*

Some 10 lb should be added for aviation dress

(14) *Miscellaneous*

An allowance of 10 lb is sufficient for instruments, such as compass, altimeters, etc. Fire extinguisher, 8 lb Tool kit, 5 lb First-aid kit, 5 lb.

(15)

In a subsequent section we shall deal with weights of such parts of the machine as cables, wires, turn-buckles, fabrics, dopes, wheels, etc, etc

Some General Considerations on Distribution of Weight and Useful Load

F W Lanchester has approached the question of weight distribution for various sizes of machines in a very interesting article The subject offers many difficulties, and the following

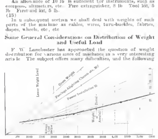

Fig 1

notes, mainly based on Mr Lanchester's article, are merely an introduction

When estimating the structural weight of a new machine from data available on one constructed, certain theoretical considerations are available.

Simple and reasonable assumptions in dealing with the main planes are that the wing section remains geometrically similar, and the velocity [illegible] from ordinary considerations of aerodynamics, the span must vary as the square root of the gross weight, and conversely the loading on the wing will vary as the square of the span The direct forces of tension and compression on the spars will vary directly as the loading and square of the span, but the cross-sectional areas of the spars will also vary as the square of the span,

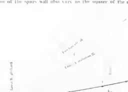

Fig. 2

geometrically similar wings will, therefore, be equally strong as regards direct forces. The bending moments will vary as the gross weight or loading multiplied by the span, i.e as the cube of the span But the resisting moment of the spars will vary as the section modulus or cube of the linear dimensions, geometrically similar wings will, therefore, be equally strong as regards bending moments It follows that with constant velocities geometrically similar wings will be equally strong for both direct and bending stresses From the weight of aerofoil point of view, the position is unfavorable, since the weight will vary as the cube of the linear dimensions or cube of the span

It follows that the weight of the wings will vary as $W^{3/2}$ where W is the gross weight.

In the interplane bracing, the wires, which only take direct stresses, will be equally strong when geometric similarity is maintained For the struts just as for the spars, the same will apply Therefore, the interplane bracing will also vary as $W^{3/2}$

For the body it is possible to make the somewhat more favorable assumption that its weight is directly proportional to the gross weight With increase in span, it is by no means necessary to increase the arm of the tail surfaces proportionately, while the resisting moment of a body cross-section varies as the depth squared and the breadth Current practice also seems to bear out the above assumption. It might even prove to be true that on large machines a slight saving in weight of body would be possible

The shock of landing to be taken up by the chassis depends, for the same landing speed, on the gross weight.

If a chassis for a large machine were geometrically similar to that of a smaller machine, it would probably show greater strength in the struts, and equal strength in the shock absorber The question is very complex. Mr Lanchester insists on the analogy of the greater relative diameter of the legs of such a large animal as an elephant as compared with the legs of a flamingo But with very big landing gear so much becomes possible in the way of shock absorption that keeping the weight of the chassis a constant proportion of the gross weight seems feasible.

For the power installation, no general discussion seems possible, and Mr Lanchester has assumed this to be 25 per cent of the gross weight in the graphs of Fig. I and Fig 2.

The construction of these is easily followed The bounding line of these curves is drawn at 45° to the Case line, so that its ordinates represent the gross weight, just as the abscissae for the same point represent the gross weight In accordance

with the above considerations, the total structural weight is taken as a constant proportion of the gross weight, namely, 25 per cent The power installation weight is taken as 25 per cent, as previously mentioned The weight of aerofoil curve, varying as $W^{3/2}$, is obtained from present-day English practice in biplane construction, with a factor of safety of 6—somewhat lower than American practice. The military load is kept at 500 lb in one case, at 150 lb in the other, and the remainder is allotted to the supply of petrol

The above remarks, the distribution of weights, and these two curves are open to criticism However, they are the conclusions of a most eminent authority, and may serve as a useful guide in the preliminary design of a machine, particularly as regards possible endurance, which can at once be derived from the petrol capacity They also give an idea of the limitations of the airplane Thus the curves of Fig. 1 show the lowest possible weight level, with a big load of 500 lb, and if extended to greater gross weights would show where, with increased size, the petrol capacity begins to diminish Fig 2 would be particularly useful in considering the possibilities of a speed scout with a single passenger

Reference for Part 2 Section 3

"THE DEVELOPMENT OF THE MILITARY AEROPLANE by F W Lanchester *Engineering*, March 1 1916

ERRATUM

A serious error was made in Part 2 Section 1 The figures for the Standard H-3 should read

Weight loaded, 2700 lb
Weight bare 1900

Corresponding corrections should be made in loading per horsepower and per square foot of wing area

Book Reviews

THE ESSAYS OF AN AVIATOR

(London *Aeronautics* 170 Fleet Street E. [illegible])

This work is published anonymously for reasons which are best stated in the author's words

"Wrapped in the cloak of anonymity I have crept into these pages and taken up again the pen I thought I had discarded for ever It is a good feeling Up in the air one loses identity or, rather gives it to the machine A man animates the clothes he is wearing much more than the clothes submerge their personality in him. And so in the air one becomes merely a complex piece of mechanism the soul of an airplane, some say but as others more truly phrase it the slave of a machine"

It makes fascinating reading, under striking subtitles: "Of beginnings of anticipation, of history, of education, of art, and of war

Readers seeking technical information will not find it, but a philosophic, almost poetic study of the effects of this newest achievement of man makes a most charming diversion from our usual reading"

AERONAUTICAL ENGINES

By E. J. Kean

([illegible] New York N. Y. [illegible] plates $2.00)

This book is the outcome of a course of ten lectures given by the author in London to men of the Royal Navy Air Service Royal Flying Corps, designers and engineering students

Mr Kean is very careful to point out in his preface that in his lectures he was teaching—not merely lecturing, and the book demonstrates this thoroughly

Very little new information is to be found in the volume, but it will be invaluable to anyone making early studies of aeronautical engines Such subjects as carburetion, ignition and balancing are treated from fundamental principles in the most authoritative fashion The illustrations are very apt and the text follows them closely

FLYING MEN AND THEIR MACHINES

By Clarence Winchester ("Orais")

(Price $2.00 net E. P. Dutton & Co., New York N. Y. 242 pages)

This book is an excellent sample of popular books on aviation, and contains an interesting short biographical notice of such well-known pilots as Pemberton-Billing, Bleriot, Hamel, and others An interesting account is given of Warneford's destruction of Zeppelins and of other exciting adventures.

The chapter on "How Aeroplanes Fly" should be particularly valuable for those first taking up the subject of aviation The section devoted to aeroplaning, trick flying, and cross-country flying might make useful reading for pupils at flying schools.

"The Naval Flying Corps Monthly"

A newcomer in the field of aeronautical publications has been received at the office of AVIATION AND AERONAUTICAL ENGINEERING It is called *The Naval Flying Corps Monthly*, and is published at the United States Navy Aeronautic Station, Pensacola, Fla. The editors have wisely started their adventure without too pretentious beginnings, but the quality of the first issue gives promise of even better things to come Besides giving the news of the station, the magazine contains

(C) International Film Service

MISS KATHERINE STINSON IN JAPANESE COSTUME

articles both humorous and serious, which should be of interest to all who wish to keep in touch with the personalities as well as the developments in the industry

The table of contents of the first issue is as follows "Our Title," "Efficiency in Flight," "The Retreat from Agua Calientes," "The Aeronaut's Cycle of Virtue," "Altitude Effect on Motors," "Station News" and "Side Slips" AVIATION AND AERONAUTICAL ENGINEERING extends a hearty welcome to the newcomer

Aeronautical Patents

Copies of these patents may be obtained for [illegible] cents each by addressing the "Commissioner of Patents, Washington D. C."

ISSUED FEBRUARY 20 1917

1,216,577 Filed Aug 23 1912 To James S Lang, Boston Mass A flying machine

1,216,952 Filed April 8 1910 To Antonio Barras and Fernando Iriarte Buenos Aires, Argentina An airplane

ISSUED JANUARY 27 1917

1,217,518 Filed January 21 1914 To Max Singelmann Chicago Ill An airship

1,217,679 Filed July 2 1917 To Rene Arnoux, Paris, France Anemometric regulator for airplanes

1,217,657 Filed April 11 1916 To Joseph A. Steinmetz, Philadelphia Pa Method of destroying aircraft

1,217,165 Filed March 12 1915 To Oskar Grunbeding Dusseldorf Germany Telescope-sight for airships and flying machines

MARCH 6 1917

1,218,586 Filed June 25 1915 To Joseph A Steinmetz, Philadelphia Pa Destruction of submarines.

1,218,[illegible] Filed May 1 1916 To Chauncey B Forward, Jr and Louis D Forward Urbana Ohio. An airplane

1,218,456 Filed Jan. 17 1916 To Charlie Peterson Florence Wis. assignor of one half to Harvey Bowman Florence Wis and Charles Erickson Chaumanwaith Wis An airship

1,218,330 Filed March 22 1916 To Justus M. Smith Oakhurst, N J Toy parachute

Air Maneuvers at Mineola

Squadron flying and air maneuvering were inaugurated at the Mineola flying field under the direction of Captain J E Carberry on Wednesday, March 7 Hereafter it is the intention of the authorities who are organizing the First Aero Squadron Signal Reserve Corps, to hold squadron maneuvers every Saturday afternoon

The first problem was undertaken under conditions of remarkable difficulty as the ground was covered with deep snow, slightly crusted. In places the crust was not sufficiently strong to bear the weight of an airplane and a runway had been shoveled in the snow for starting and landing

The maneuver problem was a simple one drawn up with a view to instructing the applicants for commissions in the Signal Officers' Reserve Corps Aviation Section in the correct methods of making military reports.

The problem as issued by Captain Carberry read as follows:

AIR PROBLEM No 1

It is assumed an unknown number of enemy aircraft have left Tingler L. I. with the intention of photographing the encampments in the vicinity of Mineola. Information is desired as to the number, type and movements of these aircraft. For the purposes of the problem all observers will report in writing at the conclusion of the assigned task in lieu of delivering reports in person at headquarters.

An enemy airplane fleet simulated by three L. W. F. machines piloted by Leonard Bonney, A. Livingston Allan and Harold Blakely, all student instructors at the Mineola Army School, left the field about 3 o'clock with instructions to attempt to return after half an hour without being seen by the cordon of defenders.

Half an hour after the "enemy" had left the field fifteen "defending" airplanes were sent up with orders to patrol across Long Island from Oyster Bay to Freeport.

Everything seemed to go wrong at the start. In the first place word was sent that a squadron of airplanes from Governor's Island, which had been expected to act as the enemy air fleet would not take part because they could not rise from the snow at their station. It was then decided to use three of the L. W. F. machines at the school to represent the enemy.

So bad was the condition under foot that it was found impossible to get a heavy automobile through the snow to the L. W. F. hangars on the opposite side of the big field from headquarters, to carry the pilots to their machines. It was necessary to fly them over to the planes. For the first time in history, perhaps, an air machine was called in to do a job of transportation that a land truck could not handle.

18 MACHINES FOR MANEUVERS

By 3 o'clock things were ready. There are thirty-five machines now at the school, but only eighteen were used in maneuvers. All these, however, were out in front of their hangars in the snow.

Soon a few machines began to go up to "feel out the air." One of the first of them was the Curtiss machine, No. 171, with Student Instructor A W Briggs, formerly a captain in the Royal Flying Corps of Great Britain, as pilot and Bert B Acosta, the former Curtiss instructor, as observer. Capt. Briggs rolled up to the shoveled pathway and then swept along it for the take off.

He had gone about 100 yards and was just lifting from the ground when a sudden gust of wind hurled his machine into a mound of snow alongside. The tip of the lower plane caught in the embankment and the machine turned turtle. The propeller was broken. Neither Briggs nor Acosta was injured

Photo by Central News Photo Service

LANDING IN THE SNOW AT MINEOLA

RISING FROM THE SNOW

Thereafter the pilots avoided the shoveled pathway. Someone discovered that he could get off right from the field. Thereafter they all did it. The machines landed on the snow too. This required extremely difficult pancake landings, as anything like a tail high landing would have been sure to cause the machine to nose over and turn upside down.

About 5 o'clock the first of the enemy planes returned to the field. The defenders flew for the most part at from 4,000 to 5,000 feet. Allan, flying at a height of 5,600 feet, came in over Hicksville. He had seen a number of the home air fleet, but came through with only a few of them having been able to distinguish him by the black and white stripes painted on the body of his airplane. Bonney, flying at 8,200 feet, passed over the cordon and so did Blakeley who kept lower.

The three airplanes were "spotted" by a number of the pilots who were instructed to turn in reports in writing.

NOT A PUBLIC EXHIBITION

The work was not an exhibition, for the school is under military control and the general public is not allowed inside the gates. It was a maneuver pure and simple, its purpose being partly to test the men and partly to determine the possibilities of an aerial attack on the field, or nearby fortifications and camps on New York. Similar tests are to be held every Saturday during the coming summer.

The Aviation Section of the Signal Corps is expected to organize a Reserve Pursuit Squadron under command of Captain R C Bolling, S O R C, at a field adjoining the Army school flying field at Mineola. The commissioned personnel of this squadron will be picked by Captain Bolling from those officers and enlisted men of the 1st Aero Company, N G N Y, who learned to fly at Mineola last summer as well as the Governor's Island fliers.

The following Lieutenants of the Signal Officers' Reserve Corps piloted "defending" machines in the March 7 maneuver: Ivan P Wheaton, A J Coyle, L F Smith, H B Willetts, H H Salmon, Jr., R M Olyphant, Daniel Morse, H F Wehrle, Charles Post, Hartlock Simon and W H Watkins and Instructor Briggs Millman, Bjorkland and Norton.

Other commissioned officers who will probably be with the First Reserve Squadron will include Captains R C Bolling, Philip A Carroll, Charles Reed, and James E V Smith, and Lieutenants J E Rainey, Stevenson, Alexander Blair Thaw, D G Frost, Ford Meyer and D R Noyes.

New Altitude Record

The Aero Club of Italy has just been notified of a new altitude record of 25,800 feet, which was established on November 7, 1916 by Guido Guidi an aviator who was flying a twin-engined Caproni. The record indicates the height above the camp—Mirafiori near Turin—which Guidi reached. The altitude above sea level he attained was 26,082 feet. The performance sets a new world's record for airplane altitude achievements. The best previous performance was made by H. G. Hawker a British flier in April, 1916. He reached a height of 23,905 feet.

Mr Boeing Presents Wind-Tunnel

Mr W E Boeing, of Seattle, has presented to the University of Washington a fully equipped research laboratory for aero-dynamics to further research of the scientific side of aeronautics. The laboratory will be one of three of its kind in the United States and will consist principally of a steel lined wind tunnel approximately six feet square and twenty-five feet long. The new laboratory will be located in one of the buildings of the engineering group

Count Ferdinand von Zeppelin

Count Ferdinand von Zeppelin died at Charlottenburg Prussia, on March 8, 1917, in his seventy-ninth year. Born at Lake Constance in 1839 he was a soldier until his retirement from active military command in 1891 When he retired the Count held the rank of General of Cavalry

The first lighter-than-air craft with which Count von Zeppelin had practical experience was one owned by the Union Army in the American Civil War Count von Zeppelin was military attaché with the Union Army during the war He made one or two ascents in a captive balloon which was in use in the Army of the Mississippi in 1863

It was not till 1874 however, that Zeppelin began preliminary experiments on dirigible balloons, and he did not commence construction work until he had retired from the Army Originally the Zeppelin was meant to assist the Post Office but its reconnaissance value was also appreciated In starting his work Count von Zeppelin said

I intend to build a vessel which will be able to travel to places which cannot be approached by other means of transportation, and for observations of hostile fleets and armies, but not for active participation in actual warfare. My dirigible balloon must be able to travel several days without renewing provisions, gas or fuel.

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To-day, when Zeppelins are adjudged failures in the popular estimation it is interesting to recall that before he had ever built a single airship Count von Zeppelin realized and stated that they were not built for offensive operations

When the Count began his work he had to take many pioneering steps. He decided that a gas volume of at least 400,000 cubic feet was necessary for his purposes Such a volume was unheard of at that time and it necessitated the introduction of rigid construction Wood and steel were considered but finally aluminum was adopted for the interior structure

In 1900 despite the jeers of the German people the first Zeppelin was completed Its dimensions were

Diameter	38 ft 1 in
Length	419 ft 10 in
Largest cross section area	1,140 sq ft
Gas capacity	400,000 cu ft

This machine has been called the work of a "rank amateur" and the work of a soldier who was not a trained engineer As a matter of fact it was the work of a man whose hobby had been lighter than air craft from 1874 to 1891 and whose time had been wholly devoted to practical application of his theoretical knowledge from 1891 to 1900

The first Zeppelin could hardly have been called a success Its structure stood up it lifted its calculated load but its primitive power plant and steering rudders failed The machine was wrecked

But Count von Zeppelin was not discouraged The first airship, with all its faults, furnished a good basis for the development of the rigid system While the popular impression, frequently voiced, was that Count von Zeppelin had "water on the brain" he continued to expend his time and money in scientific and systematic experimentation

Popular scoffing stopped suddenly in 1907 and the pendulum swung in the other direction Emperor William said of Zeppelin "He is the greatest German of the twentieth century" when the inventor brought the Zeppelin III literally to His Majesty's feet after a successful flight of over two hours The Reichstag gave him $125,000 to continue his experiments He was permitted to use the profits of a public lottery to increase his funds

Before the war broke out Count von Zeppelin had built the Sachsen type of dirigible It is interesting to compare the Sachsen of 1914 with the first rigid dirigible of 1900 The Sachsen's dimensions were

Diameter	48 ft 6 in
Length	478 ft 11 in
Gas capacity	786,000 cu ft

Since the war military requirements have dictated attempts to use Zeppelins offensively This has resulted in the building of Zeppelins of the following dimensions

Diameter	75 ft 5 in
Length	587 ft
Gas capacity	1,150,000 cu ft
High speed	75 m p hr

At the outbreak of the Great War in 1914 the German people looked to Count von Zeppelin's inventions to bring their enemies to their knees Count von Zeppelin's death, following closely upon the practical abandonment of Zeppelin warfare, was probably hastened by the failure offensively of his aircraft

Navy Lets Contracts for 16 "Blimps"

The Navy Department announced March 12th purchase of 16 non-rigid dirigibles in accordance with bids which were opened on March 1th in specifications which were published in AVIATION AND AERONAUTICAL ENGINEERING of March 1st

The Curtiss Aeroplane Co. was awarded contracts for 3 "Blimps" at $40,750 each; The Connecticut Aircraft Co. two at $42,400 each; The Goodyear Tire and Rubber Co. nine at $40,000 each and The B F Goodrich Co. two at $41,500 each. According to the contracts deliveries are to begin within 120 days.

The machines are to operate from shore bases, but could rest on the water in good weather. The gas bags will be 160 by 31 feet. Each dirigible will carry two men and will be equipped for radio communication. They will have 100 hp engines, a safe altitude limit of 7,500 feet and at 600 feet a maximum speed of 45 m p h for ten hours. At 35 miles an hour they will carry fuel for sixteen hours running

Lieut.-Col Bennett to Head Aviation Section

Lieutenant-Colonel James B Bennett, a recent graduate of the San Diego course in aviation for field officers, has been chosen for Officer in Charge of the Aviation Section, to succeed Brigadier General Squier the new Chief Signal Officer.

General Squier will continue to supervise the work of the Aviation Section

Christofferson Plant to Re-Open

The Christofferson Aircraft Manufacturing Company's plant at Redwood City, Cal. which has been closed since the death of Silas Christofferson a few months ago is about to re-open, according to newspaper reports from the Pacific Coast

At a recent meeting attended by representatives of San Francisco capital, Lansing Tevis, president of the Christofferson Aircraft Manufacturing Company, and E. T McGettigan manager of the Redwood City Chamber of Commerce, plans were adopted for reopening the plant upon an enlarged scale A representative of the San Francisco capitalists is reported as having said:

"The Christofferson plant will soon be running full blast and its output will be more than planes and engines. The plans of the people that I represent do not permit of my giving out names at present, but it is sufficient that they have the necessary capital and they gave me instructions to go ahead and arrange with Mr Tevis for the refinancing of the engine and airship corporations. The plant will not only be utilized as an up-to-date engine and airplane factory, but also for carrying out other far reaching manufacturing plans."

Secretary of Manufacturers' Association

Benjamin L. Williams was appointed Secretary of the Aircraft Manufacturers' Association at a meeting held in New York City on February 27

Small Airplanes with Big Engines

In an address before The Aeronautical Society of Great Britain on February 7 F Handley Page a British aeronautical engineer produced an interesting technical paper in which he attempted to prove that there is no such thing as a "limiting size" to airplanes The discussion which followed Mr Page's paper is full of hints dealing with foreign practice and the trend of foreign design

F W Lanchester the chairman of the meeting held that the present is the day of the small airplane

The general trend of opinion may fairly be stated as being that structural weight must necessarily increase faster than the size of airplanes There is therefore a limit to the possible size of airplanes

An opinion which was held by Captain F S Barnwell, R. F C, Wing Commander A M Longmore, R N, and E C Gordon England was that the best land fighting machines were composed of the largest and lightest possible engine with the smallest possible fringe of airplane around it, that large airplanes are clumsier to handle and maneuver ability is what gives mastery of the air, that for war purposes big machines must be accompanied by protecting high speed pursuit type airplanes and that big machines with several power units are more vulnerable than if they have centralized power systems

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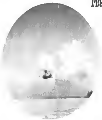

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Aeronautical Trade Directory

Aviation and Aeronautical Engineering will furnish information and addresses of all companies listed below. Names of Advertisers in this issue are printed in heavy face type

ACETYLENE WELDING AND CUTTING
Davis Bournonville Co
Imperial Brass Mfg Co
Searchlight Co

ACCESSORIES AND INSTRUMENTS
DuVilier, Earnest J
Moto-Meter, The Co
Waltham Watch Co [illegible]
Standard Aeronautical [illegible]

AIRPLANES
Aeromarine Sales and Engineering Corp
American Aircraft Co of Indiana
Anderson Aeroplane Co
Barnhart G Edward
Brico Aeroplane Co
Benoist Aeroplane Co.
Burgess Co., The
Curtiss Bros Aeroplane Co.
C & Aeroplane Works
Cooper John D Aeroplane Co
Chicago Aero Works
Christofferson Aircraft Mfg Co
Curtiss Aeroplane and Motor Corp
Davenport Aviation School
Empire State Aircraft Co
Gallaudet Aircraft Corp
General Aeroplane Co.
Grinnel Aeroplane Co
Heath E B Aerial Vehicle Co
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Herrmann, Chas. A.
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Janney Aircraft Co
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Lanzius Aircraft Co
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Miller Aeroplane Co
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New York Aero Construction Co
Pacific Aero Products Co
Pierce Sperry Aeroplane Corp.
Richardson Aeroplane Co
Rumsey Aeroplane Co.
Smith, Kyle, Aircraft Co.
Standard Aero Corporation.
Stephens Aeroplane Co
Sturtevant Aeroplane Co.
Thomas-Morse Aircraft Corp
United Eastern Aeroplane Co
Williams Aeroplane Co
Wittemann-Lewis Aircraft Co.
Wright-Martin Aircraft Corp

AIRPLANE ENGINES
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Brooke, Thomas Preston
Christofferson Motor Co
Curtiss Aeroplane and Motor Corp
Dayton Aero Motors Co
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Duesenberg Bros Motor Co
Federal Ordnance Co.
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Hyer Motor Co
Hall-Scott Motor Car Co.
Harriman Aircraft Motors Co, Inc.
Kemp Machine Works
Kluyskens, G J
Knox Motors Co
Maximotor Co
Miller Harry A Mfg Co
New Jersey Aeroplane Co
Orio Motor Co
Packard Motor Co
Roberts Motor Mfg Co
Smith John W
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Sturtevant, B. F. Co.
Taft Pierce Mfg Co
Thomas-Morse Aircraft Corp
Torn Engineering Co
Union Gas Engine Co
Wisconsin Motor Mfg Co.
World's Motor Co
Wright-Martin Aircraft Corp.

AIRPLANE PARTS
Chicago Aeronautical Supply Co.

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Aluminum Co of America
American Metal Co, Ltd.
So Luminum Mfg & Eng Co (Solder)

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Christofferson Aviation School
Curtiss Training Schools
Davenport Aviation School
Denine Deuther Aeroplane Co
Dodge School of Aviation
Grand Rapids Aviation School
Hall Flying School
Pacific Aero Products Co
Philadelphia School of Aviation
Staten Island School of Aviation
Stinson School of Aviation
Thomas-Morse Aircraft Corp
Williams Aviation School
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Hess Bright Mfg Co
New Departure Mfg Co
Norma Company of America
S K F Ball Bearing Co

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French American Balloon Co
Goodyear Tire and Rubber Co
Jarrey Stellmetz and Co (Hydrogen Cylinders)
Stevens Leo A
United States Rubber Co
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Houstetter A
Sussfeld & Lorsch
Taylor Instrument Co.

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Fabrig Metal Co.
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Master Carburetor Co.
Miller Carburetor Co
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Lee H D Mercantile Co
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Miller Aeroplane Co
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Johns Manville Co H W
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Ferdinand, L. W., & Co

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LIFE PRESERVERS
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Cold Light Mfg Co
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[illegible]

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Berkshire Magneto Corp
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Remy Electric Co
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Wading River Mfg Co

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Harley Davidson Co
Hendee Mfg Co
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Sheppard Ideal Oil Co
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